HYDROPHOBIC-HYDROPHILIC PROPERTIES OF TITANIUM DIOXIDE THIN FILMS

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Abstract

The self-cleaning of super-hydrophobic micro- to nano-structured surfaces was first observed to be a property of some plants (e.g. leaves of Lotus). Researchers try to copy nature but with synthetic surfaces. Hydrophobic-hydrophilic properties and photocatalytic behavior of nanoscale materials and nanocoatings is receiving growing interest in nanoscience and technology research, given the foreseeable introduction of commercial products into markets. For example recent studies have shown that it is possible to disinfect air by photocatalytic techniques similar to those proven successful in killing microorganisms in water. Nanocomposite and nanostrucutured thin films can be tailored in order to show easy-release, hydrophobic and anti-microbial properties, particularly of interest for technological applications where nanocoatings are applied on plastics, glass, fiberglass and technical textiles products.

Titanium dioxide is among the few semiconductors that have good chemical/photochemical stabilities and high oxidation power. However, its relatively high band gap makes it only effective when exposed under UV light. It has been found that the addition of some metals to TiO_2 and/or plasma treatment during film growth can improve the photocatalytic activity by UV irradiation and extend its use in the visible region of the electromagnetic spectrum.

In this work, transparent photocatalytic titanium dioxide (TiO_2) thin films were deposited onto microscope glass slides, polycarbonate substrates and textile surfaces by means of the DC reactive magnetron sputtering method using Ar and O_2 as working gases. The film surface morphology and roughness were characterized by atomic force microscopy (AFM). The contact angle and surface energy were measured in order to study the hydrophobic-hydrophilic properties of undoped and undoped titanium dioxide nanocoatings. Fe-doped and Nd-doped TiO_2 films were also prepared to study the effects on the photocatalytic activity of the TiO_2 thin films. The influence of total sputtering pressures and iron doping concentrations on the surface properties of the TiO_2 thin films were investigated.